Received: 19 January 2022 | Revised: 23 March 2022 | Accepted: 28 March 2022

DOI: 10.1111/phpp.12788

Photodermatology, Photoimmunology & Photomedicine WILEY

ORIGINAL ARTICLE

What type of face mask should we choose in coronavirus disease 2019 pandemic considering photoprotective effectiveness?

Sung Jin Park[1] | Jun Hyuk Cho[1] | Min Seok Ham[1] | Soo Hong Seo[1] | Hyo Hyun Ahn[1] | Dai Hyun Kim[1,2]

[1]Department of Dermatology, Korea University College of Medicine, Seoul, South Korea

[2]Department of Anatomy, Korea University College of Medicine, Seoul, South Korea

Correspondence
Dai Hyun Kim, Department of Dermatology, Korea University College of Medicine Goryeodae-ro 73 (Anam-dong 5ga), Seongbuk-gu, Seoul, 02841, Korea.
Email: mightycell@naver.com

Funding information
This study was supported by the Basic Science Research Program through the National Research Foundation (NRF) of Korea funded by the Ministry of Education (NRF-2020R1I1A1A01075468).

Abstract

Background: Wearing a face mask is one of the most effective personal protective strategies to diminish the spread of coronavirus disease 2019 (COVID-19). Several dermatological outcomes were reported because of the prolonged use of face masks, especially due to the constant mask-on policy, but the photoprotective effect of face masks has received less attention.

Objective: The aim of this study was to provide guidance in the use of face masks by comparing the photoprotective effects of routinely used masks.

Methods: A total of 12 frequently used face masks were tested, including certified respirators, Korea filter (KF)94, KF-anti-droplet (KF-AD), and KF80. The amount of light that penetrates each face mask was measured using a light sensor that can quantify Ultraviolet A (UVA), visible light (VL), and infrared A (IR-A) rays.

Results: Black-colored KF94 masks and surgical masks reduced penetration of UVA, VL, and IR-A by approximately 100%. The UVA penetration decreased on average by 95.51%, 90.97%, 85.06%, and 86.41% with white-colored KF94, KF-AD, KF80, and surgical masks, respectively. The VL and IR-A were blocked by approximately 75.58%, 66.16%, 59.18%, and 64.48% with white-colored KF94, KF-AD, KF80, and surgical masks, respectively.

Conclusion: In conclusion, the different photoprotective effectiveness of face masks was mainly determined by colors, and therefore, black-colored, multi-layered respirators can be recommended in terms of photoprotection in the COVID-19 pandemic. The quantified comparative results will be helpful to the person with pre-existing photo-aggravated dermatosis, especially in the season of the high intensity of sunlight.

KEYWORDS
COVID-19, face mask, photoprotection

1 | INTRODUCTION

Face masks are one of the most effective personal protection products to slow down the spread of coronavirus disease 2019 (COVID-19).[1,2] Mask wearing has been recommended by public health authorities to minimize the spread of exhaled respiratory droplets and possibly resultant airborne transmission of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).[1,2] Public health authorities recommend wearing face masks in indoor public places and crowded outdoor settings, especially in the circumstances of substantial or high transmission.[3–5] In particular, South Korea (hereinafter Korea) has received considerable attention from the media worldwide for its exceptional adherence to face masks, which cannot be solely explained by mandatory policies on mask wearing.[6–8] Consequently, a large number of people have been exposed to the effects of prolonged mask wearing on facial skin, and studies on the long-term use of face masks have mostly focused on the negative impact, including increased skin sensitivity, irritation, itching, and exacerbation of pre-existing dermatoses such as acne and rosacea, among others.[9–11]

However, prolonged coverage by face masks is expected to have positive photoprotective effects because masks can be grossly regarded as an ultraviolet (UV) protective fabric—an important physical protective agent.[12,13] Ultraviolet A (UVA) and visible light (VL) have been regarded as causative factors in skin aging, pigmentation, and erythema.[14–17] In addition, it has been suggested that infrared A (IR-A) plays an important role in photoaging as well as dermal inflammation.[18] In this context, the purpose of the study was to quantify the degrees of photoprotective effectiveness against UVA, VL, and IR-A by frequently used face masks and provide guidance in the use of face masks, especially in the season of high UV index during which sun protection is essential.[19]

2 | MATERIALS AND METHODS

2.1 | Face masks and study design

Easily purchasable face masks that are widely used in Korea were screened and selected for this study. The Korea Disease Control and Prevention Agency suggested using the Ministry of Food and Drug Safety (MFDS)-approved respirators such as Korea filter (KF)94, KF80, KF-anti-droplet (KF-AD), or surgical masks,[6] as the majority of Koreans have been accustomed to wearing the certified masks. KF94 is the Korean equivalent of filtrating facepiece (FFP)2 respirators in Europe and N95 respirators in the United States of America (USA).[3,4,16] KF80 is a comparable grade corresponding to FFP1.[3,20]

2.2 | Measurement of photoprotective effectiveness of face mask

The amount of light that reached the surface of the cheek, naked as well as covered by a face mask, was evaluated in triplicate at noon from July to August 2021 in an open field in Seoul (37°N and 126°E) with a light sensor (TM-208; Tenmars Electronics Co., Ltd., Taipei, Taiwan). The light sensor could measure the degree of UVA rays (320–400 nm, peak sensitivity 365 nm) and rays with comparably longer wavelengths, VL and IR-A (peak sensitivity 400–1100 nm). The light sensor could measure up to 4000 μW/cm^2 and 2000 W/m^2 of UVA rays and VL and IR-A, with the minimum resolution of 0.1 μW/cm^2 and 0.01 W/m^2, respectively. The accuracy of the light sensor was ±4% for UVA rays and ± 5% for VL and IR-A.

The light sensor was placed on the facial surface while the investigator gazed forward with the head positioned on a horizontal plane parallel to the ground during the measurement. The placement of light sensor along with or without masks is illustrated in Figure S1. The light sensor was intended to be placed not to alter the original curvature of face masks as much as possible. In addition, the investigator pressed every direction to avoid measuring exaggerated value due to unintentionally penetrated light from a slight gap between mask and skin surface. The intensity of light was recorded as the average intensity of 5 s. The investigator consistently placed a light sensor on the same region and wore the face masks with the coherent head position in the same place and time to minimize the interference by unintended variables.

2.3 | Statistical analysis

Statistical differences in the reduction in UVA, VL, and IR-A by different face masks were analyzed using analysis of variance or the Kruskal–Wallis test. All analyses were performed with IBM SPSS version 20.0, for Windows (IBM Corp., Armonk, NY, USA), and p-values <0.05 were considered statistically significant.

3 | RESULTS

3.1 | Characteristics of face masks

A total of 12 different face masks were used in the study, as illustrated in Figure 1, and detailed properties are provided in Table 1 according to types, colors, number of layers, materials, companies, and weight per unit area. All respirators were approved by the MFDS and categorized into KF94, KF-AD, and KF80. Frequently used surgical and reusable masks were also used in this study.

3.2 | Environmental and measurement conditions

The study was conducted on three different clear and sunny days in July and August at noon. The average temperature and humidity were 31.23 ± 2.11°C and 50.67 ± 2.08%, respectively. The average particulate matter (PM) parameters, PM2.5 and PM10, were 10.00 ± 6.24 and 15.67 ± 8.62, respectively. The average UV index was 7.33 ± 1.53 and could be categorized as high to very high degrees of UV exposure.[19]

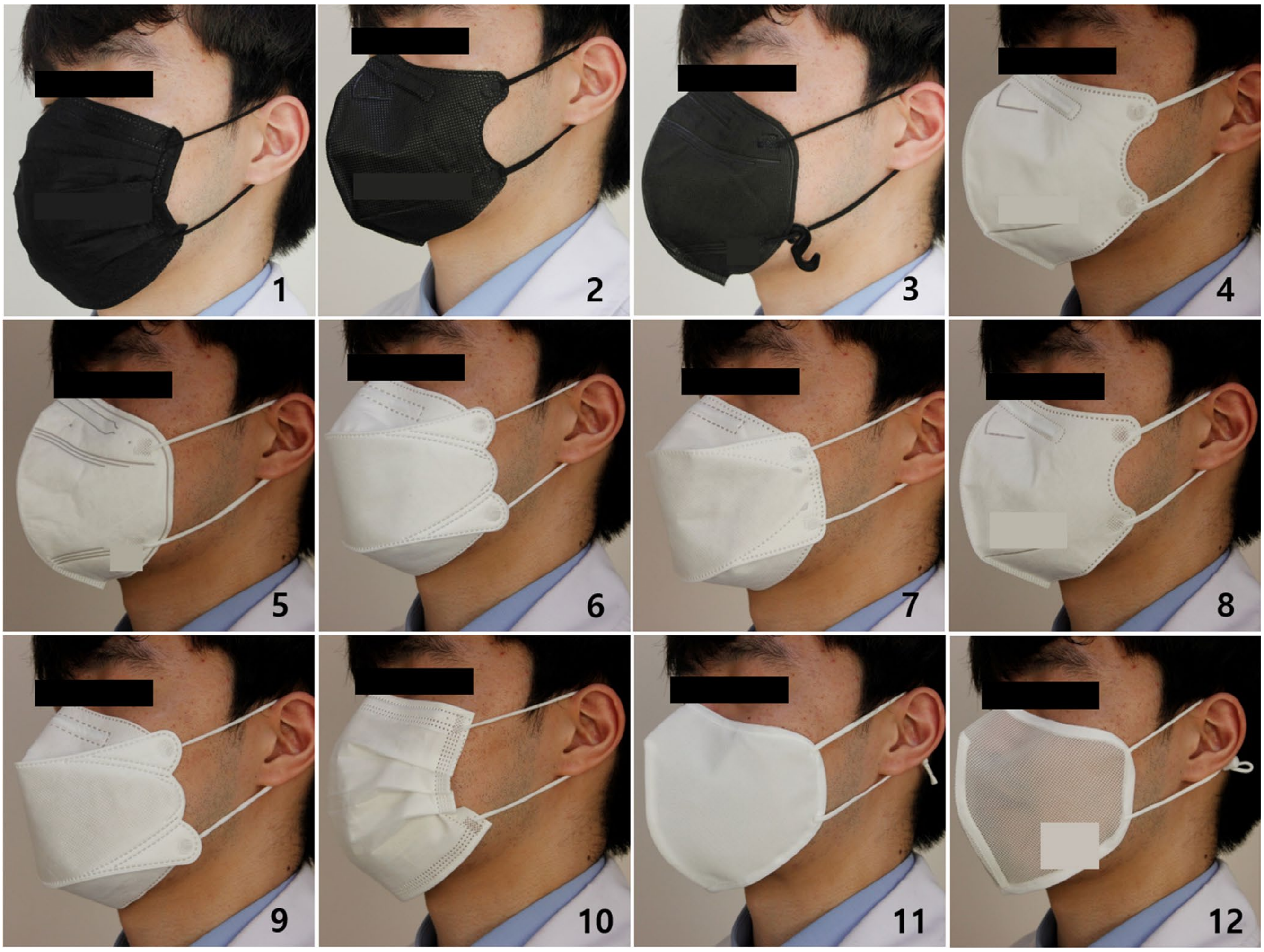

FIGURE 1 Illustrations of commercially available face masks in Korea that were tested. Detailed properties including types, colors, and symbolized company names are described in Table 1

3.3 | Performance of face masks in UVA reduction

The measured values of UVA on bare and masked skin surface are documented in Table 2. The degree of UVA reduction by different face masks is shown in Figure 2. The black masks numbered from 1 to 3 consisted of one surgical mask and two KF94 types. The black masks showed nearly 100.00% blockage of UVA penetration, with masks 1, 2, and 3 blocking 99.55 ± 0.78, 100.00 ± 0.00, and 100.00 ± 0.00% of UVA rays, respectively. The white-colored KF94 masks numbered 4 to 6 showed 96.78 ± 4.46, 98.22 ± 2.74, and 91.52 ± 5.54% of UVA reduction, respectively. The white-colored KF-AD mask numbered 7 and KF80 masks numbered 8 and 9 resulted in 90.97 ± 2.27, 88.74 ± 5.07, and 81.37 ± 7.20% of UVA reduction, respectively. The white-colored surgical mask numbered 10 showed an 86.41 ± 5.55% reduction in UVA. The white-colored and translucent reusable masks numbered 11 and 12 displayed 89.45 ± 5.34 and 45.69 ± 7.09% of UVA reduction, respectively. Both the black-colored surgical and KF94 masks showed statistically significant UVA reduction compared with the results of white-colored KF80 and surgical masks ($p < 0.01$ and $p < 0.05$, respectively). Black-colored KF94 masks provided numerically higher UVA reduction when compared to white-colored KF94 and KF-AD masks, although no statistical significance was found. The white-colored KF94 masks resulted in a statistically superior UVA reduction in comparison with white-colored KF80 masks ($p < 0.01$).

3.4 | Performance of face masks in VL and IR-A reduction

The measured values of VL and IR-A on bare and masked skin surface are documented in Table 2. The degree of VL and IR-A reduction by the 12 face masks is presented in Figure 3. The black-colored masks numbered 1 to 3 also showed nearly 100.00% blockage of VL and IR-A penetration, and corresponding to 99.75 ± 0.15, 99.41 ± 0.03, and 99.44 ± 0.08%, respectively. The white-colored KF94 masks numbered 4 to 6 showed 80.77 ± 4.19, 74.87 ± 4.43, and 71.11 ± 8.20% of VL and IR-A reduction, respectively. The white-colored KF-AD mask numbered 7 and KF80 masks numbered 8 and 9 resulted in 66.16 ± 7.70, 65.76 ± 1.97, and 52.60 ± 18.19%

TABLE 1 Characteristics of various facial masks used in the study

No.	Type	Color	Numberof layers	Material(s)	Company	Weight (g) per unit area (3 × 3 cm)
1	Surgical	Black	3	PolypropelenePolyethylene	a	0.12
2	KF94	Black	4	PolypropelenePolyethylene	a	0.19
3			3	Polypropelene	b	0.13
4	KF94	White	4	PolypropelenePolyethylene	a	0.14
5			3	PolypropelenePolyethylene	b	0.13
6			3	Polypropelene	c	0.10
7	KF-AD	White	3	Polypropelene	d	0.08
8	KF80	White	3	PolypropelenePolyethylene	a	0.08
9			2	Polypropelene	c	0.10
10	Surgical	White	3	Polypropelene	e	0.05
11	Reusable	White	3	Micro-nanofiber(Polyester)	f	0.19
12		Translucent	3	Micro-nanofiber(Polyester)	f	0.09

TABLE 2 Measured values of ultraviolet A (UVA) and visible light (VL) and infrared A (IR-A) on bare (control, Ctrl) and masked skin surface. The amount of light was assessed in triplicate at noon from July to August 2021 in an open field in Seoul, South Korea

No.	Type/color of facial mask	UVA (μW/cm^2)			VL and IR-A (W/m^2)		
Ctrl	–	74.3	54.4	133.6	280.4	128.2	507.0
1	Surgical/black	1.0	0.0	0.0	0.3	0.5	1.1
2	KF94/black	0.0	0.0	0.0	1.6	0.8	3.1
3		0.0	0.0	0.0	1.4	0.7	3.3
4		1.0	0.0	11.1	40.4	27.2	111.8
5	KF94/white	0.3	0.0	6.6	56.7	33.8	146.1
6		7.8	1.2	17.0	65.3	49.1	127.2
7	KF-AD/white	7.9	3.5	13.4	70.3	50.6	187.5
8	KF80/white	7.0	4.0	22.7	92.9	42.4	185.1
9		19.3	6.3	24.5	89.3	86.4	217.8
10	Surgical/black	9.1	4.8	26.3	68.1	68.9	144.6
11	Reusable/white	12.3	3.4	11.7	116.3	45.7	206.9
12	Reusable/translucent	46.3	28.2	65.2	191.0	73.4	376.0

of VL and IR-A reduction, respectively. The white-colored surgical mask numbered 10 showed 64.48 ± 15.93% of VL and IR-A reduction. The white-colored and translucent reusable masks numbered 11 and 12 displayed 60.70 ± 3.21 and 33.49 ± 8.56% of VL and IR-A reduction, respectively. Both the black-colored surgical and KF94 masks showed statistically significant VL and IR-A reduction compared with the results of the other masks, including white-colored KF94, KF-AD, KF80, surgical and both reusable masks ($p < 0.01$). The white-colored KF94 masks resulted in statistically superior VL and IR-A reduction compared with the white-colored KF80 masks ($p < 0.05$).

4 | DISCUSSION

As of October 2021, SARS-CoV-2 has infected more than 243.87 million people and led to 4.95 million deaths.[21] The common mode of SARS-CoV-2 transmission is exposure to large respiratory droplets during close contact.[1,2,4] The optimum use of face masks including N95 respirators and surgical masks give effective protection compared with that with no mask.[1,2] An N95/N99 respirator is the USA equivalent of FFP2/FFP3, which means the mask filters at least 94% and 99% of airborne particles.[3] FFP is the categories of masks used in European standard of testing face masks.[3] FFP1 is the grade of mask that filters at least 80% of particles. The efficacy of FFP1/FFP2 corresponds to the KF80/KF94 grade of masks certified by MFDS in Korea.

As a personal protection strategy in the COVID-19 pandemic, many people practice prolonged mask wearing, and the dermatological effects on facial skin have naturally gained attention in the field of dermatology.[9–11,22,23] Prolonged wearing of face masks has been associated with negative impact on the biophysical properties of skin[10,11,22] and an aggravation of de-novo or pre-existing dermatoses including mask-induced acne, perioral dermatitis, and contact

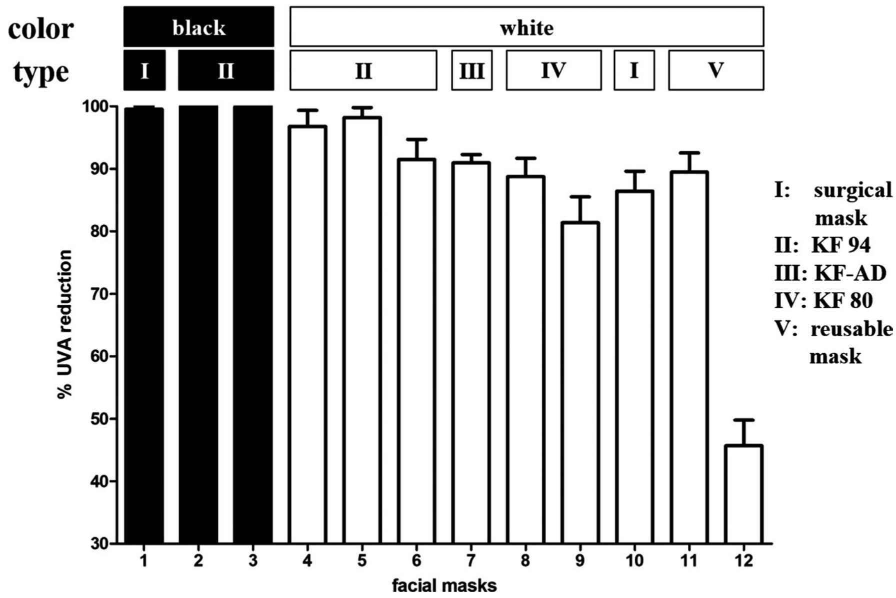

FIGURE 2 Percentage reduction in ultraviolet A (UVA) by face masks with different properties including colors (black and white) and types (I: surgical mask, II: KF94, III: KF-AD, IV: KF80, V: reusable mask). Values reflect the average difference between the masked and bare skin. Error bars show standard error

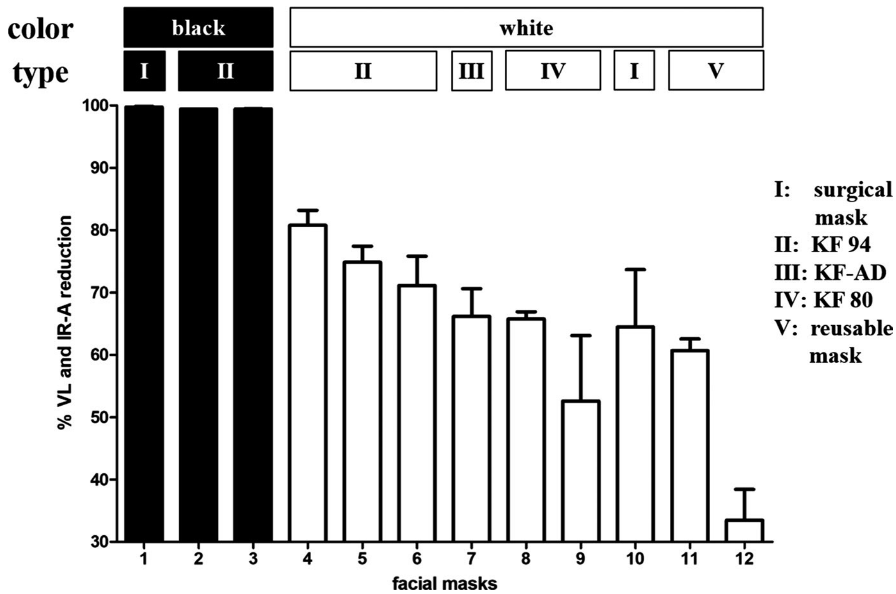

FIGURE 3 Percentage reduction in visible light (VL) and infrared A (IR-A) by face masks with different properties including colors (black and white) and types (I: surgical mask, II: KF94, III: KF-AD, IV: KF80, V: reusable mask). Values reflect the average difference between the masked and bare skin. Error bars show standard error

dermatitis.[9,23] Despite the above-mentioned multiple negative influences, face masks can be regarded as effective physical photoprotective agents covering a most central facial area known to be the most heavily sun-exposed areas and therefore prone to have photosensitive drug eruption, chronic actinic dermatitis, and actinic keratosis.[24] In addition, the covering of central face by the face mask with higher photoprotective function can prevent the accumulation of UV-induced image on high-risk zone for basal cell carcinoma and squamous cell carcinoma, where Mohs micrographic surgery is most benefited.[25] Our previous study also reported that centrofacial area was vulnerable to the exposure of VL and infrared rays even in automobile.[14] Although face masks cannot cover the entire facial skin, it is still important to investigate which products provide better photoprotective effectiveness and analyze causative reasons.

The photoprotective efficacy of face masks is affected by the color, types of materials, thickness, hydration, etc.[12,13] One study reported the level of photoprotection offered by surgical, fabric, and homemade masks against UV radiation.[12] However, no previous study has evaluated the photoprotective effectiveness of respirators. Therefore, this study was designed to quantify the photoprotective effectiveness of face masks, including MFDS-approved respirators, and to analyze the difference in efficacy according to their color, number of layers, types of materials, and weight per unit area.

UVA, VL, and IR are well-known factors causing skin aging.[14,26] In addition, UVA and VL induce erythema and increased pigmentation, particularly in darker skin.[13–15,26] IR-A penetrates into the deep dermis and contributes to the loss of collagen fiber.[26] Moreover, the photocarcinogenic property of UVA has been well documented.[26] Our results showed that black-colored KF94 masks and surgical mask blocked the exposure to UVA, VL, and IR-A by approximately 100% (Figures 2 and 3). Black-colored face masks showed a statistically significant reduction in VL and IR-A compared with all the other products and a numerically higher degree of UVA reduction, although statistical significance was only found in comparison with white-colored KF80 and surgical masks. Further examinations, including the black- colored KF80 mask of company a, were conducted to additionally verify the determining photoprotective effect of color. The triplicate examinations proceeded on different sunny days at noon in March 2022 in the same place in Seoul. The black-colored KF80 mask demonstrated 100.00 ± 0.00% reduction in UVA and 98.52 ± 0.24% blockade of VL and IR-A, similar to the formal results of black-colored KF94 and surgical masks. Therefore, dark color seemed to be a superior determining factor in the photoprotective effectiveness of face masks regardless of the types, number of layers, materials, and weight per unit area.

White-colored KF94 is one of the most frequently used face masks in Korea, and three types of white KF94 masks showed more than 90% reduction in UVA and 70% reduction in VL and IR-A reduction (Figures 2 and 3). The slight individual difference among masks 4, 5, and 6 (Figures 2 and 3) seemed to be influenced by multiple factors including the number of layers, composed materials, and weight per unit area (Table 1). The number of layers might cause the better result of the mask numbered 4 compared with the other white KF94 masks.

White-colored KF80 is preferred by people who favor its easier breathability compared with KF94 but showed statistically inferior UVA as well as VL and IR-A reduction when compared to white-colored KF94. The plausible explanation regarding the individual difference between the masks numbered 8 and 9 could be the number of layers and composed materials. The respirators are non-woven fabric generally composed of three different layers: the outermost waterproof layer, the middle filter piece, and an innermost absorbent layer.[27] The KF80 mask numbered 8 is composed similarly of three layers; an outermost layer, a filter in the middle with polypropylene (PP), and an innermost layer with polyethylene (PE)/PP. The other KF80 mask, numbered 9, comprised only two layers: the outermost layer and the PP filter (Table 1). The bicomponent PE/PP membrane of the mask numbered 8 may be benefited from the distinct three-dimensional fluffy structure[27,28] and this additional layer might be the reason for the difference.

The white-colored reusable mask composed of polyester showed similar photoprotective effectiveness toward UVA, VL, and IR-A compared with the results of white-colored KF80 and surgical masks. However, the results of translucent reusable mask regarding photoprotection were consistently inferior to those of all other products. The individual differences between masks numbered 11 and 12 (Figures 2 and 3) seemed to be determined by color, possibly due to fabric construction and weight per unit area (Table 1).

In conclusion, our data show that frequently used face masks showed meaningfully different photoprotective effectiveness, mainly determined by colors and partly influenced by types of masks and number of layers. Based on the result of our study, black-colored, multi-layered respirators can be recommended in terms of photoprotection. Considering the pandemic situation where the wearing mask has been universal, the result can be helpful to the general population who need an additional way of photoprotection in the season of the high UV index and the patients with pre-existing photo-aggravated dermatosis.

CONFLICT OF INTEREST

None to declare.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Dai Hyun Kim https://orcid.org/0000-0002-3546-2366

REFERENCES

1. Wiersinga WJ, Rhodes A, Cheng AC, Peacock SJ, Prescott HC. Pathophysiology, transmission, diagnosis, and treatment of coronavirus disease 2019 (COVID-19): a review. *JAMA*. 2020;324(8):782-793.
2. Chu DK, Akl EA, Duda S, Solo K, Yaacoub S, Schünemann HJ. COVID-19 systematic urgent review group effort (SURGE) study authors. Physical distancing, face masks, and eye protection to prevent person-to-person transmission of SARS-CoV-2 and COVID-19: a systematic review and meta-analysis. *Lancet*. 2020;395(10242):1973-1987.
3. European Centre for Disease Prevention and Control. Using face masks in the community: first update – Effectiveness in reducing transmission of COVID-19. Accessed October 26, 2021. https://www.ecdc.europa.eu/en/publications-data/using-face-masks-community-reducing-covid-19-transmission
4. Centers for Disease Control and Prevention. How to protect yourself & others. Accessed October 23, 2021. https://www.cdc.gov/coronavirus/2019-ncov/prevent-getting-sick/prevention.html
5. Korea Disease Control and Prevention Agency. Mask wearing to become mandatory. Accessed October 28, 2021. https://www.kdca.go.kr/board/board.es?mid=a30402000000&bid=0030
6. National Public Radio. Coronavirus FAQ: Why am I suddenly hearing so much about KF94 masks?. Accessed October 28, 2021. https://www.npr.org/sections/goatsandsoda/2021/01/22/959683338/coronavirus-faq-why-am-i-suddenly-hearing-so-much-about-kf94-masks
7. Cable News Network. South Korea mandates mask-wearing to fight Covid-19 as face coverings remain controversial in the US. Accessed October 28, 2021. https://edition.cnn.com/2020/10/13/asia/south-korea-masks-coronavirus-intl-hnk/index.html?form=MY01SV&OCID=MY01
8. Voice of America. Face mask culture common in East, new to West. Accessed October 28, 2021. https://www.voanews.com/a/science-health_coronavirus-outbreak_face-mask-culture-common-east-new-west/6186770.html
9. Olisova OY, Teplyuk NP, Grekova EV, Lepekhova AA. Dermatoses caused by face mask wearing during the COVID-19 pandemic. *J Eur Acad Dermatol Venereol*. 2021;35(11):e738-e741.
10. Park SR, Han J, Yeon YM, Kang NY, Kim E. Effect of face mask on skin characteristics changes during the COVID-19 pandemic. *Skin Res Technol*. 2021;27(4):554-559.
11. Kim J, Yoo S, Kwon OS, Jeong ET, Lim JM, Park SG. Influence of quarantine mask use on skin characteristics: one of the changes in our life caused by the COVID-19 pandemic. *Skin Res Technol*. 2021;27(4):599-606.

12. Couteau C, Paparis E, Coiffard L. What level of photoprotection can be obtained using facial mask? Determining effectiveness using an in vitro method. *Dermatol Ther*. 2021;34(3):e14837.
13. Jansen R, Wang SQ, Burnett M, Osterwalder U, Lim HW. Photoprotection: part I. Photoprotection by naturally occurring, physical, and systemic agents. *J Am Acad Dermatol*. 2013;69(6):853.e1-853.e12. quiz 865.
14. Kim DY, Ahn TM, Kye YC, Seo SH. Topographic approach to the long-term effect of solar exposure on facial skin of Korean automobile commuters. *Skin Res Technol*. 2019;25(2):124-128.
15. Mahmoud BH, Ruvolo E, Hexsel CL, et al. Impact of long-wavelength UVA and visible light on melanocompetent skin. *J Invest Dermatol*. 2010;130(8):2092-2097.
16. Kohli I, Chaowattanapanit S, Mohammad TF, et al. Synergistic effects of long-wavelength ultraviolet A1 and visible light on pigmentation and erythema. *Br J Dermatol*. 2018;178(5):1173-1180.
17. Callender VD, St Surin-Lord S, Davis EC, Maclin M. Postinflammatory hyperpigmentation: etiologic and therapeutic considerations. *Am J Clin Dermatol*. 2011;12(2):87-99.
18. Holzer AM, Athar M, Elmets CA. The other end of the rainbow: infrared and skin. *J Invest Dermatol*. 2010;130(6):1496-1499.
19. Chacko AM, Lagacé F, Jafarian F. Ultraviolet index and sun safety: are we all on the same page? *Br J Dermatol*. 2021;184(6):1175-1176.
20. National Institute of Food and Drug Safety Evaluation. Guideline for the standard specification of health mask. Accessed October 27, 2021. http://www.nifds.go.kr/brd/m_15/view.do?seq=12951
21. Worldometer. COVID-19 coronavirus pandemic. Accessed October 23, 2021. http://worldometers.info/coronavirus/
22. Park M, Kim H, Kim S, et al. Changes in skin wrinkles and pores due to long-term mask wear. *Skin Res Technol*. 2021;27(5):785-788.
23. Kang SY, Chung BY, Kim JC, Park CW, Kim HO. Clinical manifestations and patch test results for facial dermatitis associated with disposable face mask use during the COVID-19 outbreak: a case-control study. *J Am Acad Dermatol*. 2021;85(3):719-721.
24. Shibayama Y, Imafuku S. Comparison of facial predilection sites for cutaneous squamous cell carcinoma and actinic keratosis in Japanese patients. *J Dermatol*. 2014;41(12):1102-1105.
25. Findlay MW, Soufan C. Nonmelanoma skin cancer. In: Farhadieh RD, Bulstrode NW, Mehrara BJ, Cugno S, eds. *Plastic Surgery – Principles and Practice*. 1st ed. Elsevier; 2021:97-113.
26. Runger TM. Cutaneous photobiology. In: Kang S, Amagai M, Bruckner AL, et al., eds. *Fitzpatrick's dermatology*. 9th ed. McGraw-Hill Education; 2019:265-288.
27. Chua MH, Cheng W, Goh SS, et al. Face masks in the new COVID-19 Normal: materials, testing, and perspectives. *Research*. 2020;2020:7286735-7286740.
28. Liu J, Zhang H, Gong H, Zhang X, Wang Y, Jin X. Polyethylene/polypropylene bicomponent Spunbond air filtration materials containing magnesium stearate for efficient fine particle capture. *ACS Appl Mater Interfaces*. 2019;11(43):40592-40601.

SUPPORTING INFORMATION

Additional supporting information may be found in the online version of the article at the publisher's website.

How to cite this article: Park SJ, Cho JH, Ham MS, Seo SH, Ahn HH, Kim DH. What type of face mask should we choose in coronavirus disease 2019 pandemic considering photoprotective effectiveness? *Photodermatol Photoimmunol Photomed*. 2022;00:1–7. doi: 10.1111/phpp.12788